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April 19, 1995
File #530-3.3

APR 27 REC'D

Mr. Frank F. Faranca, Case Manager
New Jersey Department of Environmental Protection
Division of Responsible Party Site Remediation
Bureau of Federal Case Management
CN028
401 East State Street
Trenton, New Jersey 08625-0028

NJD 002325074

Re: Lenox China NJPDES-DGW Permit Renewal Application
Response to NJDEP's March 20 Comment Letter

Dear Mr. Faranca:

This letter responds to your March 20, 1995 comment letter regarding the Lenox NJDEP-DGW permit application and the corresponding Groundwater Sampling and Analysis Plan (GWSAP). The responses are in the same order as the Department's comments.

NJPDES-DGW Permit Application

1. A revised Form SRP-1 which addresses the proposed use of treated groundwater for spray irrigation will be submitted to NJDEP.
2. Iron is not a compound related to the Lenox operation and it has been detected in upgradient well MW-1 at concentrations exceeding the 100 µg/l PQL. The scientific literature indicates that iron naturally occurs in the Cohansey aquifer at concentrations exceeding the PQL. Notwithstanding this position, the Table in Part III will be revised to reflect the PQL exceedance. Lenox requests that NJDEP acknowledge that iron is not a parameter related to past or present Lenox operations.

Groundwater Sampling and Analysis Plan

Well Evacuation Procedures

1. The total well depth will be measured before purging the well.

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Continued . . .

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2. The GWSAP will be revised to include monitoring wells MW-4, MW-6, and MW-10.

Well Sampling Procedures

1. The Department indicates that VOC analysis is not required during the RCRA detection monitoring program. The GWSAP will be modified accordingly.

NJDEP also indicated that samples from the detection monitoring wells must be analyzed for sodium, sulfate, ammonia-nitrogen, total dissolved solids, and dissolved oxygen. Lenox believes that, except for lead and zinc, which are the primary contaminants of concern based on Lenox operations and the RFI findings, additional detection monitoring for sodium, sulfate, ammonia-nitrogen, and total dissolved solids cannot be justified (dissolved oxygen is routinely tested for as a field parameter).

Geraghty & Miller (G&M) submitted a report to NJDEP in 1991 which outlined the rationale for requesting modifications to the Lenox DGW permit standards for the parameters mentioned above ("Justification of Alternative Ground-Water Standards for the Lenox China NJPDES Permit NJ0070343", January 1991). The report also included a risk assessment to justify the report recommendations. I have enclosed a copy of the report for your reference. G&M concluded that there were no human health or environmental risks posed by the concentrations of sodium, sulfate, ammonia-nitrogen, and total dissolved oxygen found during the DGW monitoring program, and that the concentrations of these parameters found during the monitoring program should decrease over time because the RCRA units are no longer used. G&M's findings were based on the monitoring data base developed over a nine year period between 1982 and 1991. The additional three and one half years of data collected between 1992 and 1995 substantiate the G&M findings and conclusions. Lenox therefore requests that NJDEP limit the required detection monitoring analyses to only unfiltered lead and zinc.

2. Tables 1 and 3 will be revised pending NJDEP's response to Item 1 above.
3. Table 2 will be revised pending NJDEP's response to Item 1 above.

Continued . . .

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Analytical Procedures

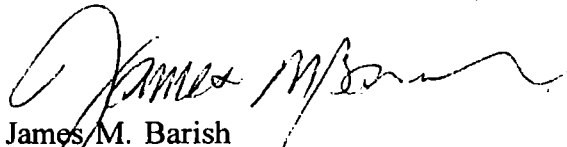
1. Table 4 will be revised pending NJDEP's response to Item 1 above.

The revised pages to the NJPDES-DGW permit application will be submitted to NJDEP as soon as the Department approves the changes requested in this letter.

Please call me if you have any questions.

Very truly yours,

EDER ASSOCIATES



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Project Manager/Hydrogeology

JMB/mw

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MW3671

**JUSTIFICATION OF ALTERNATIVE
GROUND-WATER STANDARDS
FOR THE LENOX CHINA
NJPDES PERMIT NJ0070343**

January 1991

**Geraghty & Miller, Inc.
Environmental Services
125 East Bethpage Road
Plainview, New York 11803**

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2. Average Concentrations of Iron, Manganese, Sodium, Ammonia-Nitrogen, Sulfate, and Total Dissolved Solids Detected in Ground Water at the Lenox China Facility, Pomona, New Jersey.

APPENDICES

- A. September 19, 1989 Compliance Evaluation Inspection Report and October 30, 1989 Transmittal Letter.
- B. Correspondence Related to Permit Renewal:
 - November 29, 1989 letter from Geraghty & Miller to the NJDEP;
 - December 15, 1989 letter from the NJDEP to Lenox;
 - January 19, 1990 letter from Lenox to the NJDEP.

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- C. Ground Water Monitoring Database, November 1982 through August 1990, Lenox China Facility, Pomona, New Jersey.
- D. Risk Assessment for Selected Monitoring Constituents, Lenox China Facility, Pomona, New Jersey, NJPDES Permit No. NJ0070343.

JUSTIFICATION OF ALTERNATIVE
GROUND-WATER STANDARDS
FOR THE LENOX CHINA NJPDES PERMIT NJ0070343

INTRODUCTION

At the request of Lenox, Incorporated, Geraghty & Miller, Inc. has prepared this report to justify proposed modifications to the ground-water monitoring requirements and standards included in NJPDES Permit NJ0070343 for Lenox's manufacturing facility in Pomona, New Jersey. Specifically, this report was generated in response to Paragraph 18 of Part III-DGW of the permit and proposes alternative monitoring requirements and standards for iron, manganese, sodium, ammonia-nitrogen, sulfate, and total dissolved solids (TDS). A brief summary of previous correspondence between Lenox and the New Jersey Department of Environmental Protection (NJDEP) on this subject is presented below, followed by our rationale for each of the proposed modifications.

BACKGROUND

On September 19, 1989, a Compliance Evaluation Inspection of the Pomona facility was performed by the NJDEP; a copy is included in Appendix A. As a result of this inspection, it was determined by the NJDEP that certain permit limitations were exceeded. Among these were standards for iron, manganese, sodium, ammonia-nitrogen, sulfate, and total dissolved solids.

In response to this notification, Lenox retained Geraghty & Miller to prepare a report addressing the ground-water quality results that had exceeded the limits specified in the NJPDES permit that was in effect at the time (NJPDES Permit No. NJ0005177). In a November 29, 1989 letter report, provided in Appendix B, Geraghty & Miller explained that most of the values in excess of the permit levels listed by the NJDEP did not result from

current discharge, but rather from naturally occurring levels of certain constituents or from non-hazardous materials no longer associated with the facility. The report also petitioned for the modification of the monitoring parameters and limits included in the permit (see Table 1).

In recognition of the arguments presented in the November 29th letter, as noted in the NJDEP's December 15, 1989 letter to Lenox (Appendix B), monitoring requirements for pH changed, and nitrate and coliform bacteria were dropped from Permit No. NJ0070343, which became effective on August 1, 1990. Several other parameters included in the old permit were also eliminated because no values in excess of the standards occurred during the quarterly ground-water monitoring. In addition, a special condition (Paragraph 18 of Part III-DGW) was included in the current permit at the request of Lenox in its January 19, 1990 letter to the NJDEP (Appendix B) that would exempt Lenox from violations of permit limits for iron, manganese, ammonia-nitrogen, sulfate, and TDS if Lenox could demonstrate in a report submitted within 180 days of August 1, 1990 that the presence of these parameters in concentrations above the original ground-water standards would have little, if any, environmental impact.

RATIONALE FOR PROPOSED MODIFICATIONS

Paragraph 18 of Part III-DGW states, in part, that "...Lenox shall submit to the Department a report demonstrating that its operations do not discharge iron and manganese into the groundwater or otherwise indirectly cause increased concentrations of these parameters. The report shall also demonstrate that little, if any, environmental impact is being caused by excess levels of iron, manganese and the remaining above listed parameters in Tables 1 and 2. The report may also propose alternative remedies to eliminating and/or reducing the sources or causes of these excess levels. Following submission of the report, the Department will major modify the permit to establish either GW2 Ground Water Criteria or limits higher than the secondary standards."

As discussed below, sulfate and TDS are the only parameters which have a connection to active plant operations (the use of plaster--calcium sulfate--for china molds). The use of plaster for china molds is essential to the fine china manufacturing process and cannot be eliminated or reduced from the waste stream without terminating manufacturing operations. The process water is currently being treated for sulfate and TDS to the full extent permitted by state-of-the-art systems.

The following comments for all parameters are based on two studies. The first is an examination of average concentrations of each parameter at monitoring wells and surface stations sampled since 1982. See Appendix C for a complete listing of the facility ground-water monitoring database. The averages are presented in Table 2 and are based on all samples collected, including those that yielded a concentration below the detection limit. For those samples, a concentration equal to half the detection limit was factored into the average. By studying the distribution of average concentrations, possible sources of excess concentrations were determined and the potential for offsite migration of concentrations above permit limits was assessed.

The second study was a risk assessment to evaluate potential environmental impacts from contaminant concentrations above present permit limits. The study is presented in Appendix D and is referenced in the discussions that follow. To evaluate potential risk, a worst case was assumed: that ground water at the site would be used as a drinking water supply with concentrations of sodium, ammonia-nitrogen, sulfate, and TDS at the proposed permit limits and concentrations of iron and manganese at the peak concentrations detected in the last two years. It was also assumed that surface water downgradient from the site would contain these parameters at identical concentrations. Neither of these scenarios is realistic. However, it is our intention, through the use of conservative assumptions, to demonstrate conclusively that the named constituents will not have a significant environmental impact.

Iron

Iron is not used in the manufacturing process in the plant. In fact, it is an impurity that lowers the quality of the product and is, therefore, to be avoided. As discussed in the November 29, 1989 letter, iron is a naturally occurring element commonly found in the Cohansey aquifer at levels exceeding the current permit limit (0.3 mg/L). In a 1968 study of ground-water resources in Atlantic County performed by the U.S. Geological Survey (USGS) in cooperation with the State of New Jersey, iron concentrations in 15 ground-water samples from the Cohansey aquifer ranged between 0.02 and 1.6 mg/L and had a median concentration above the current permit standard (0.35 mg/L) (USGS, 1968). A similar study in adjacent Cape May County (USGS, 1962) found that "iron concentrations [in the Cohansey aquifer] range from 0.08 to 4.0 ppm; objectionable quantities of iron were present in 20 of the 32 samples." It should also be noted that high iron concentrations in the waters of southern New Jersey are not a recent phenomenon. A large number of Revolutionary War iron foundries were located in what is now Atlantic County because of abundant surface deposits of iron that precipitated naturally from iron-rich water in ponds and bogs.

Concentrations of iron above permit limits were detected in October 1985 (0.38 mg/L) and January 1987 (0.4 mg/L) in Well 1, which is upgradient from the facility and unaffected by plant activities. Of the remaining wells, average concentrations above the permit limit were found at Well 3 (3.3 mg/L), Well 4 (0.82 mg/L), Well 8 (1.3 mg/L), Well 9 (8.0 mg/L), and Well 10 (1.2 mg/L). The average concentration for Well 4 is distorted by an anomalously high value of 21 mg/L from September 1984 and 1.7 mg/L in January 1985, occurrences probably arising from problems of filtration in the field or analytical difficulties in the laboratory. In 24 quarterly analyses on Well 4 samples since January 1985, iron has not been detected in this well above the permit limit; the average iron concentration in Well 4 with the two high values excluded is less than 0.1 mg/L, which is far lower than the existing permit level of 0.3 mg/L.

The average for Well 3 is similarly skewed by an anomalously high value of 28.0 mg/L from November 1982. Were it not for this value, the average iron concentration in Well 3 would equal 1.7 mg/L, which is similar to the averages for Wells 8 and 10. All three averages are in reasonable agreement with the range of concentrations detected in samples collected during the 1968 USGS study of Atlantic County (0.02 to 1.6 mg/L).

The only well with an average concentration that is significantly higher is Well 9, which has averaged 7.8 mg/L over the past four years. Well 9 is located adjacent to the recently closed slip basin and the elevated levels of iron detected in that well may reflect past reducing conditions in the vicinity of the basin, which enhanced the leachability of natural iron from the soil.¹ Since the basin has been closed, these conditions are likely to abate in time, resulting in progressively lower iron concentrations. In any event, the average iron concentration in Well 10, which is approximately 260 ft downgradient from the slip basin, is over 80 percent lower than the average concentration in Well 9, indicating that the elevated iron concentrations are highly localized and will naturally dissipate to ambient levels before migrating offsite.

Based on the risk assessment, regular consumption of ground water having an iron concentration of 10.2 mg/L (the highest level detected in the last two years) would have an insignificant health risk, as represented by a hazard quotient of 0.0044 (a quotient of less than 1 is considered acceptable). If surface water downgradient from the site were to contain iron at a concentration of 10.2 mg/L, the potential for chronic impact to an aquatic

¹ Iron is the fourth most abundant element in the earth's crust, making up approximately 2 percent (20,000 mg/kg) of common soils. Iron has two common ionic oxidation states in nature, +2 (ferrous) and +3 (ferric). When oxygen is present the low solubility ferric iron is predominantly present, and little iron, therefore, is expected in ground water. In contrast, when soils are inundated or bacterial activity depletes the oxygen, soluble ferrous iron is usually present. The high biological activity associated with the sugar binder in the Slip Basin is a plausible cause for the reducing (oxygen-deficient) conditions required to create soluble ferrous iron. This naturally occurring iron is apparently entering the ground water in the area of Well 9. The appearance of iron in this well does not result from the discharge of iron from Lenox processes.

ecosystem would theoretically exist since the concentration exceeds the Federal Water Quality Criterion (FWQC) of 1.0 mg/L. However, since the nearest downgradient surface-water body (Clark's Mill Creek) is over 2,000 ft away, it is highly unlikely that such a level (1.0 mg/L) would reach surface water, particularly since the iron concentration in Well 10, which is nearest the Lenox property boundary, has averaged only 1.2 mg/L. If high iron concentrations were detected in a downgradient stream, it is more likely that they would result from natural conditions, since, as discussed previously, iron frequently occurs at high enough levels to precipitate naturally in surface water throughout the county.

Accordingly, since iron is not used at the Lenox facility, does not represent a hazard to human health or the environment, and arises in ground water from natural sources, Geraghty & Miller concludes that iron should be removed from the permit.

Manganese

As in the case of iron, manganese is not used at the facility and is a naturally occurring element commonly found in the Cohansey aquifer at concentrations above the permit limit of 0.05 mg/L. Concentrations exceeding the limit have been detected previously in Well 1, which is upgradient from the facility and, therefore, unaffected by plant operations, during the July 1985, October 1985, January 1986, April 1986, October 1987, January 1988, April 1988, and August 1990 sampling rounds. On three other occasions (November 1982, July 1986, and February 1989), the concentration of manganese in Well 1 samples equalled the permit limit of 0.05 mg/L. These occurrences in total correspond to over one-third of all samples collected from Well 1 and result in an average concentration for all samples of 0.38 mg/L, which is 80 percent of the permit standard. Therefore, it is likely that future samples collected from upgradient Well 1 will regularly contain manganese at concentrations exceeding the current permit standard.

The average manganese concentrations calculated for the last two years exceeded the permit limit of 0.05 mg/L in Wells 7, 8, 9, and 10. There are some early anomalous values in the database such as 2.5 mg/L for Well 4 in September 1984, which is the same year that an unusually high iron concentration was detected, suggesting that a sampling or analytical error (such as a defective filter) may have been responsible. The last 16 samples from Well 4, spanning 4 years of monitoring, have all had manganese concentrations below the permit limit.

In contrast, nearly all samples collected from Wells 7, 8, 9, and 10 have had manganese concentrations in excess of the permit limit. Well 8 has the highest average concentration of 0.34, more than twice that of the next highest well. The environmental chemistry of manganese is similar in many ways to that of iron. Since Well 8 is located adjacent to Tilton Road Pond, the values in excess of the permit levels may have resulted from local reducing conditions, which promoted the leaching of manganese from the soil. This phenomenon was described for iron in footnote 1.

Based on the risk assessment, water containing manganese at a concentration of 0.43 (the highest concentration detected in the last two years) would not present a risk to either human health or aquatic life. A hazard quotient of 0.063 (well below the target level of 1) was calculated for regular human consumption. The hypothetical exposure concentration of 0.43 mg/L used to gauge possible impact on aquatic life is approximately one order of magnitude below the level determined to have teratogenic effects on aquatic invertebrates.

Because manganese is not used at the Lenox facility, apparently arises in ground water from natural sources, and does not represent a hazard to human health or the environment, Geraghty & Miller concludes that manganese should be removed from the permit.

Sodium

Well 9, with an average sodium concentration of 71 mg/L, was the only well at the site to have an average concentration in excess of the 50 mg/L standard. Since it is located adjacent to the slip basin, the elevated concentrations in Well 9 may reflect the use of nepheline syenite, which is a sodium feldspathic mineral used as the major raw material in the formation of china pieces. Closure of the basin has removed this potential source and should result in progressively lower sodium concentrations, although the period of abatement cannot be predicted. Even if the sodium content in Well 9 should stay at its present concentration, however, it dissipates to a level below the current permit limit before migrating offsite. This is shown by the sodium concentrations detected in Well 10, which is immediately downgradient of Well 9 and near the property boundary. Sodium concentrations in Well 10 have never exceeded the permit limit and are 54 percent lower, on average, than the concentrations detected in Well 9.

The risk assessment indicates that at the proposed permit limit of 100 mg/L, regular consumption of ground water would result in a hazard quotient of 0.10, which represents an acceptable human health risk. The absence of data on the chronic toxicity of sodium to aquatic life prevented the evaluation of potential long-term effects on a freshwater ecosystem; however, the nearest surface water is far away and no aquatic effects are expected from these low levels on site.

In summary, sodium has been detected above the current permit limit of 50 mg/L in only one well at the site (Well 9). Geraghty & Miller believes that the excess sodium in this area will dissipate over time, because the Slip Basin has been closed and this source of sodium has thereby been eliminated. The current levels of sodium will not have an environmental impact, and, therefore, Geraghty & Miller concludes that a modified permit limit of 100 mg/L is justified.

Ammonia-Nitrogen

Average concentrations of ammonia-nitrogen in excess of the 0.5 mg/L permit limit exist at Well 7 (0.68 mg/L), Well 8 (1.3 mg/L), and Well 9 (1.5 mg/L). These wells are located adjacent to Lenox waste treatment impoundments [the Polishing Basin (Well 7), Tilton Road Pond (Well 8), and the former Slip Basin (Well 9)]. Therefore, it is possible that these wells have been impacted by some industrial process.

As discussed in Geraghty & Miller's November 29, 1989 letter, two possible sources of ammonia existed at the plant. From April 1981 to October 1984, Lenox used diammonium phosphate (DAP) as an agent in its sludge treatment system. The other potential source was the waste stream from the Lenox sanitary treatment system, which was decommissioned in 1987 when Lenox connected to the public sewer.

Since neither source now exists, the ammonia-nitrogen content of the ground water surrounding the Polishing Basin and the Tilton Road Pond should gradually decrease over a period of time. In addition, the Slip Basin is no longer in service and a RCRA closure has been completed. Well 8 has already shown substantial improvement resulting from the changing quality of Lenox's wastewater; ammonia-nitrogen values in Well 8 routinely exceeded 2 mg/L before January 1989 and have been below 1 mg/L in the seven monitoring rounds since. Well 7 values have similarly stayed below 1 mg/L since 1988, while Well 9 values typically remain in the range of 1 to 2 mg/L.

Even if the concentrations of ammonia-nitrogen evident in Wells 7, 8, and 9 should persist for some time, there would be no impact on the property downgradient of the facility. Well 10, the closest well to the downgradient property boundary, has never exhibited a concentration of ammonia-nitrogen in excess of the permit limit, averaging 0.16 mg/L.

Regular consumption of water containing ammonia-nitrogen at the proposed limit of 3.0 mg/L would not present a hazard to human health, based on the hazard quotient of

0.089 calculated by the risk assessment. The potential hazard to aquatic life was determined by estimating the concentration of un-ionized ammonia that would be associated with an ammonia-nitrogen exposure of 3.0 mg/L. [Un-ionized ammonia (NH_3) is much more hazardous to aquatic life than the ionized form present in aqueous ammonia-nitrogen (NH_4^+)]. Based on these calculations, the exposure concentration associated with a total ammonia-nitrogen concentration of 3.0 mg/L is 0.000375 mg/L of un-ionized ammonia, which is below the FWQC of 0.0026 mg/L.

In summary, Geraghty & Miller believes that the ammonia-nitrogen concentrations that exceed the current permit limit of 0.5 mg/L will dissipate naturally over time. At current levels, ammonia-nitrogen will not have an environmental impact and, therefore, Geraghty & Miller concludes that a modified standard of 3.0 mg/L is justified.

Sulfate and Total Dissolved Solids

The primary source of sulfate at the Lenox facility is calcium sulfate, which is used in plaster molds for making chinaware. Based on the molecular weight of its component ions (Ca^{2+} and SO_4^{2-}), calcium sulfate consists of approximately 70 percent sulfate by weight. If the TDS detected at the facility were composed solely of ionized calcium sulfate, the ratio of sulfate concentrations to TDS concentrations would also equal 0.7 to 1. At Wells 7, 9, and 10, which have the highest frequency of TDS values in excess of the permit level, the ratio of average sulfate concentrations to average TDS concentrations ranges between 58 and 61 percent, indicating that the TDS in these wells are composed mostly of ionized calcium sulfate. For this reason, Geraghty & Miller concludes that sulfate and TDS should be considered jointly in the evaluation of potential environmental impacts.

Wells 4, 7, 9, and 10 were found to have average sulfate and TDS concentrations in excess of the current permit limits (250 mg/L for sulfate and 500 mg/L for TDS). These wells are situated either adjacent to or downgradient from an existing (Polishing Basin) or former (Slip Basin) surface impoundment.

Well 7 is located immediately adjacent to the Polishing Basin, which will continue to receive calcium sulfate in the future. As such, the potential for sulfate and TDS values in excess of the permit level will continue. However, in the past four quarters, Well 7 has exhibited average concentrations of sulfate (271 mg/L) and TDS (539 mg/L) only marginally above current permit levels.

Wells 4 and 9 are situated immediately adjacent to the Slip Basin and Well 10 is located approximately 260 ft downgradient from the basin. Since the calcium sulfate bearing material in the Slip Basin has been excavated and capped, the source of sulfate and TDS in these wells has been removed and the levels of these constituents in the vicinity of the Slip Basin should gradually decrease.

If the sulfate and TDS concentrations currently evident in Well 9 were to persist for some time, monitoring data show that the excess levels naturally dissipate in the ground water downgradient from the well. The average sulfate (350 mg/L) and TDS (580 mg/L) concentrations in Well 10 are over 50 percent lower than the average concentrations in Well 9 (810 mg/L for Sulfate and 1,400 mg/L for TDS). Since these wells are located approximately 260 ft apart, and the property boundary is an additional 200 ft downgradient from Well 10, it is probable that the sulfate and TDS content of the ground water is below current permit levels at the property boundary.

As a conservative analysis, the risk assessment evaluated potential impacts to human health using the proposed permit limit of 1,000 mg/L for sulfate. Since the health impact of TDS depends on its composition, which in this case is predominantly sulfate, it was not evaluated independently for human health risks.

At a concentration of 1,000 mg/L, sulfate would be unacceptable for human consumption, based on a hazard quotient of 2.5 (adverse health effects would include diarrhea, dehydration, and gastroenteritis). However, it is highly unlikely that water containing this concentration of sulfate would ever be consumed for two reasons: (1)

concentrations of sulfate approaching this level are found only in the central portion of the facility adjacent to the Slip Basin and Polishing Basin, which, due to institutional control, will never be used as a water supply; and (2) water containing this concentration of sulfate would be aesthetically displeasing.

As a more realistic but still conservative approach, Geraghty & Miller calculated the potential health hazard posed by the consumption of water downgradient from the facility using the average sulfate concentration detected in Well 10 as a worst-case estimate. At a concentration of 350 mg/L, a hazard quotient of 0.89 would exist, indicating an acceptable health risk. Since sulfate concentrations are likely to be significantly lower offsite due to natural dissipation, Geraghty & Miller concludes that current levels of sulfate at the Lenox facility do not pose an environmental or health risk.

Neither sulfate nor TDS at the proposed permit limit was judged to represent a hazard to aquatic life, although the absence of sufficient data for sulfate prevented an evaluation of long-term effects.

In summary, Geraghty & Miller believes that excess sulfate and TDS in the vicinity of the Slip Basin should dissipate naturally over time, while marginal excesses in Well 7 are likely to continue at current levels because of the continued discharge of nonhazardous calcium sulfate to the Polishing Basin. Even at the levels previously evident in Wells 7, 9, and 10, monitoring data suggest that sulfate and TDS levels are below current permit standards at the Lenox property boundary and, based on a risk assessment, ground water and surface water downgradient from the facility would not affect human health or aquatic life.

Because calcium sulfate is an integral part of the manufacturing process at the Lenox facility, sulfate cannot be further reduced from the waste stream using current state-of-the-art systems. Therefore, Geraghty & Miller concludes that modified permit limits of 1,000 mg/L for sulfate and 2,000 mg/L for TDS are warranted.

We would be pleased to discuss further issues covered in this report related to permit limits and provide additional information as required.

Sincerely,

GERAGHTY & MILLER, INC.

Nicholas Childs

Nicholas Childs
Senior Scientist

Robert A. Saar

Robert A. Saar, Ph.D.
Senior Project Advisor

NC/RAS:vk
LENOX.RPT
January 10, 1991

REFERENCES

- U.S. Geological Survey, 1962. Ground-Water Resources of Cape May County, NJ, Salt-Water Invasion of Principal Aquifers. Special Report 18. State of New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply.
- U.S. Geological Survey, 1968. Summary of Ground-Water Resources of Atlantic County, New Jersey with Special Reference to Public Water Supplies. Water Resources Circular No. 18. State of New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply.
- U.S. Geological Survey, 1978. Water Resources Data for New Jersey, Volume 1, Atlantic Slope Basins, Hudson River to Cape May. U.S. Geological Survey Water-Data Report NJ-78-1.

Table 1. Proposed Modifications to Current Monitoring Requirements and Standards for the Lenox China Facility, Pomona, New Jersey.

Parameter	Current Standard (mg/L)	Proposed Standard (mg/L)
Iron	0.3	None/Delist
Manganese	0.05	None/Delist
Sodium	50	100
Ammonia-Nitrogen	0.5	3.0
Sulfate	250	1,000
Total Dissolved Solids	500	2,000

Table 2. Average Concentrations of Iron, Manganese, Sodium, Ammonia-Nitrogen, Sulfate, and Total Dissolved Solids Detected in Ground Water at the Lenox China Facility, Pomona, New Jersey.

Parameter (Average Concentrations in mg/L)	Well 1	Well 3	Well 4	Well 6	Well 7
Iron	0.075	3.3	0.82	0.14	0.24
Manganese	0.038	0.07	0.20	0.063	0.14
Sodium	9.9	30	47	16	46
Ammonia-Nitrogen	0.097	0.12	0.098	0.11	0.68
Sulfate	18	100	270	150	490
Total Dissolved Solids	96	350	550	270	840

-- No data.

Averages were calculated for each parameter by summing all reported concentrations from November 1982 through August 1990 and dividing by the number of samples collected. Concentrations reported as being less than the detection limit were assumed to be equal to half the detection limit and were included in the averages, which were rounded to two significant figures.

Table 2. Average Concentrations of Iron, Manganese, Sodium, Ammonia-Nitrogen, Sulfate, and Total Dissolved Solids Detected in Ground Water at the Lenox China Facility, Pomona, New Jersey.

Parameter (Average Concentrations in mg/L)	Well 8	Well 9	Well 10	Tilton Road Pond	Slip Basin	Polishing Basin
Iron	1.3	8.0	1.2	--	--	--
Manganese	0.34	.099	0.15	--	--	--
Sodium	32	71	33	38	67	78
Ammonia-Nitrogen	1.3	1.5	0.16	4.8	0.1	0.33
Sulfate	150	810	350	300	1,400	1,200
Total Dissolved Solids	300	1,400	580	580	1,900	1,500

-- No data.

Averages were calculated for each parameter by summing all reported concentrations from November 1982 through August 1990 and dividing by the number of samples collected. Concentrations reported as being less than the detection limit were assumed to be equal to half the detection limit and were included in the averages, which were rounded to two significant figures.

APPENDIX D

Risk Assessment
for Selected Monitoring Constituents,
Lenox China Facility,
Pomona, New Jersey,
NJPDES Permit No. NJ0070343

APPENDIX D

RISK ASSESSMENT FOR SELECTED MONITORING CONSTITUENTS LENOX CHINA FACILITY POMONA, NEW JERSEY NJPDES PERMIT NO. NJ0070343

The following risk assessment evaluates the potential impact on human and aquatic life from exposure to constituents detected in ground water at the Lenox China facility in Pomona, New Jersey. Potential hazards to humans from use of the ground water at the facility as a drinking- water supply are addressed first, followed by an evaluation of potential hazards to freshwater aquatic life. The constituents of concern include ammonia-nitrogen, iron, manganese, sodium, sulfate, and total dissolved solids (TDS).

For the purposes of this assessment, a hypothetical worst case was assumed: that the exposure point concentrations for both ground and surface water would be equal to the maximum concentrations of iron and manganese detected at the facility during the last two years or equal to the proposed NJPDES permit limits for ammonia-nitrogen, sodium, sulfate, and TDS. These concentrations are listed below in milligrams per liter (mg/L).

Ammonia-nitrogen	3.0
Iron	8.6
Manganese	0.43
Sodium	100
Sulfate	1,000
TDS	2,000

IMPACT ON HUMAN HEALTH

There are recognized toxic responses associated with each of the constituents of concern, excluding TDS, which is dependent on the composition of the component ions. Although an in-depth discussion of the particular responses is not included here, a major distinction should be made between carcinogenic (cancer related) and non-carcinogenic effects. None of the constituents included in this evaluation are suspect carcinogens by oral ingestion. The criterion used to evaluate the potential risk from non-carcinogenic substances is the hazard quotient, which equals the ratio of the exposure dose (ExD) to the acceptable chronic daily intake or reference dose (RfD). A hazard quotient greater than 1.0 for a constituent is an indication that exposure exceeds acceptable daily intake levels, which may result in adverse health effects.

For the six constituents under discussion, only manganese has a USEPA verified oral RfD: 0.2 mg/kg/day (USEPA, 1989a). In the absence of any established RfDs for the other constituents, acceptable dosages (AD) for chronic exposure were estimated. The ADs for iron and sodium are based on health effects information (National Research Council, 1977), while the AD for sulfate is based on a provisional Average Acceptable Daily Intake (AADI) of 400 mg/L (Federal Register, 1985). The AD for ammonia-nitrogen is based on an RfD of 34 mg/L (USEPA, 1989a), which reflects only negative organoleptic factors (taste and odor); the safe concentration may be higher but insufficient data are available to provide an accurate assessment (United States Environmental Protection Agency, 1989a). Estimated ADs for chronic exposure are 0.97 mg/kg/day for ammonia, 68 mg/kg/day for iron, 29 mg/kg/day for sodium, and 11.4 mg/kg/day for sulfate. As mentioned previously, because no toxicological information was available for TDS, an AD could not be estimated. However, because the TDS found at the facility is composed principally of sulfate, the hazard quotient for sulfate can also be used to assess potential health impacts from TDS.

Exposure doses (ExDs) were calculated using standard assumptions (USEPA, 1989b). An adult ingests 2 liters (L) of water per day for his or her entire lifetime and the average

weight of the adult is 70 kilograms (kg). The ExDs were calculated by multiplying the exposure point concentrations (mg/L) listed above by water consumption (L), then dividing by body weight (kg). The calculated exposure doses are 0.057 mg/kg/day for ammonia-nitrogen, 0.245 mg/kg/day for iron, 0.012 mg/kg/day for manganese, 2.9 mg/kg/day for sodium, and 29 mg/kg/day for sulfate.

The hazard quotients for the individual constituents (calculated as the ratio of the exposure dose to the RfD or AD) are listed below:

Ammonia-nitrogen	0.089
Iron	0.0044
Manganese	0.063
Sodium	0.10
Sulfate	2.5

The hazard quotients for ammonia-nitrogen, iron, manganese, and sodium are well below the target level of 1, while the hazard quotient for sulfate (2.5) exceeds the target level. Elevated levels of sulfate, as a soluble inorganic salt (for example, magnesium sulfate) can cause diarrhea and dehydration. Gastroenteritis has been reported in infants consuming formula with sulfate concentrations of 630 to 1,150 mg/L.

Since shallow ground water at the Lenox facility will never be used as a drinking-water supply, the hazard quotient calculated above is purely hypothetical. To provide a more realistic assessment of possible human exposure to sulfate, the potential impact to human health from the consumption of ground water downgradient from the facility was also assessed using the average sulfate concentration detected in Well 10 (366 mg/L) as a conservative estimate of downgradient water quality. At this concentration, the ExD would equal 10.6 mg/kg/day for sulfate, resulting in a hazard quotient of 0.93, which represents an acceptable human health risk.

IMPACT ON AQUATIC LIFE

The potential impact on aquatic life from exposure to each of the constituents is discussed in the following order:

1. Ammonia-nitrogen and iron, for which there are promulgated Federal Water Quality Criteria (FWQC) (USEPA, 1986), and
2. Manganese, sodium, sulfate, and TDS, for which there are no FWQC or appropriate guidelines.

Since un-ionized ammonia (NH_3) is much more hazardous to aquatic life than the ionized form (NH_4^+) present in aqueous ammonia-nitrogen, the concentration of NH_3 associated with a total (ionized and un-ionized) ammonia-nitrogen exposure dose of 3.0 mg/L was determined using percentages calculated by the USEPA (1984). These percentages depend on the pH and temperature of the water. For Atlantic County, the pH of surface water typically varies between 4 and 6, while temperature is seasonal, ranging from 0 to approximately 20°C (USGS, 1978). For this study, a pH of 5.5 and temperature of 20°C were assumed. At 20°C, the lowest pH for which the USEPA calculated a percentage is 6.5. Since solubility increases logarithmically with unit reductions in pH, the percentage of un-ionized ammonia associated with a given quantity of ammonia-nitrogen at a pH of 5.5 is an order of magnitude lower than the percentage calculated at a pH of 6.5 (0.0125 percent as opposed to 0.125 percent). Multiplying 0.0125 percent by the proposed ammonia-nitrogen level of 3.0 mg/L results in an exposure concentration of 0.000375 mg/L for un-ionized ammonia, which is below the chronic FWQC of 0.0026 mg/L.

The maximum concentration of iron detected in the ground water (8.6 mg/L) exceeds the FWQC of 1.0 mg/L. However, since the nearest ground-water discharge point is over 2,000 ft away (Clark's Mill Creek), it is highly unlikely that this concentration would occur because of natural dissipation.

There is limited toxicological data for manganese. The chronic LC_{50} for the invertebrate Daphnia magna has been reported as 5.7 mg/L, while a concentration of 4.1 mg/L resulted in a 16 percent reduction in reproductive success (Biesinger and Christensen, 1972). The hypothetical exposure concentration of 0.43 mg/L, which was detected at Well 8, is approximately one order of magnitude below the concentration demonstrated to elicit minor reproductive impairment. Thus, the potential for significant adverse effects to aquatic organisms due to a manganese concentration of 0.43 mg/L is minimal.

No chronic toxicity information was found in the available literature concerning the toxicity of sodium. In an acute bioassay with Ceriodaphnia dubia, the 48-hour LC_{50} for sodium is reported as 900 mg/L (USEPA, 1988). The hypothetical exposure concentration of sodium (the proposed permit level of 100 mg/L) is less than the acute LC_{50} . The potential long-term effects this concentration of sodium may have on a freshwater ecosystem cannot be adequately evaluated based on the available data.

There is very little information concerning the toxicity of sulfate to aquatic organisms. In acute tests, the LC_{50} s have been reported as 13,000 mg/L for bluegill sunfish and 1,900 mg/L for freshwater diatoms (Patrick et al., 1968). The proposed permit level of 1,000 mg/L is below these LC_{50} s. No information was found concerning the chronic effects of sulfate. Thus, the potential impact to aquatic life from long-term exposure to sulfate at a concentration of 1,000 mg/L cannot be evaluated based on available information.

The level of TDS proposed for the permit (2,000 mg/L) should represent no hazard to aquatic life if this concentration occurred in an aquatic ecosystem. Available information suggests that TDS concentrations in the range of 1,000 to 15,000 mg/L are the maximum tolerable levels for most freshwater fish (USEPA, 1986).

CONCLUSIONS

1. No risk to human health or the environment has been determined to exist for manganese, sodium, ammonia-nitrogen, and total dissolved solids for the levels proposed for the Lenox NJPDES permit.
2. The proposed limit of 1,000 mg/L for sulfate would be a human health concern if shallow ground water at the Lenox facility were used as a drinking-water supply. However, due to institutional controls, development of a shallow water supply on Lenox property is not expected to occur. Downgradient from the facility, sulfate in drinking water would not be a human health concern due to dispersion of the sulfate to safe levels.
3. Based on available data, the maximum concentration of natural iron mobilized from soils and detected in ground water exceeds the FWQC for the protection of freshwater aquatic life via chronic exposure. However, it is highly unlikely that this exposure would occur because the nearest ground-water discharge point is over 2,000 ft away.
4. Inadequate data prevented the evaluation of the potential impact to a freshwater ecosystem from chronic exposure to sodium and sulfate at concentrations equal to the proposed permit limits.

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